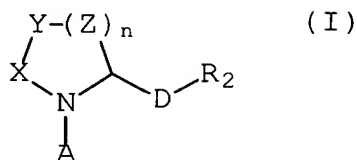


WHAT IS CLAIMED IS:

1. A compound of formula (I):



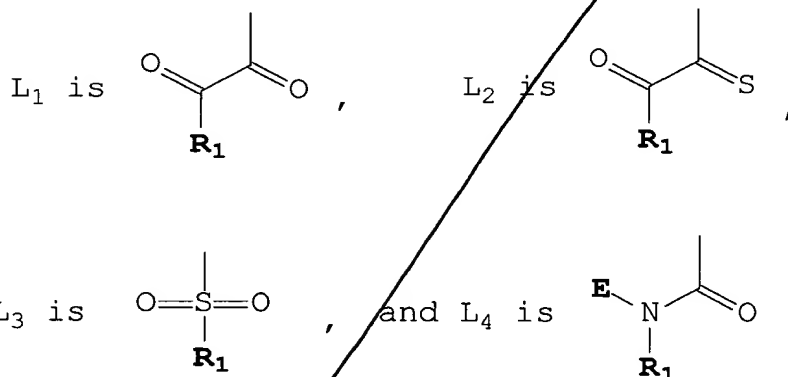
where

5 X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano,

nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester, or solvate thereof;

provided that:

R₁ is not substituted with both hydroxy and oxygen to form carboxy, or R₁ is not substituted with both alkoxy and oxygen to form alkoxy carbonyl, or R₁ is not substituted with both amine and oxygen to form amide;

further provided that:

when A is L₁ or L₂, and D is a bond, then R₂ is not COOH, or an amide;

further provided that:

when A is L₁, and R₁ is methyl, and D is a bond, then R₂ is not COOH;

further provided that:

when A is L₃, and R₁ is phenyl, methylphenyl, phenylmethyl, substituted or unsubstituted phenoxyphenyl, substituted naphthyl, or methoxyphenyl, and D is a bond, then R₂ is not COOH or an amide;

further provided that:

when A is L₃, and R₁ is phenyl, and D is a bond, then R₂ is not thiophenyl;

further provided that:

when A is L₃, and R₁ is phenyl, and D is oxyethyl, then R₂ is not an amide;

further provided that:

when A is L₃, and R₁ is substituted isoquinoline, and D is butyl,

then R₁ is not an amide;

further provided that:

when A is L_3 or L_4 , and R_1 is unsubstituted or substituted phenyl, and D is C_1 - C_3 alkyl or alkenyl, then R_2 is not $COOH$, OH , or an amide;

further provided that:

when A is L_4 , and R_1 is phenyl, halo-substituted phenyl, dimethylphenyl, substituted butyl, or methylphenyl, and D is a bond,

then R_2 is not $COOH$;

further provided that:

when A is L_4 , and R_1 is cyano-substituted alkyl, and D is a bond,

then R_2 is not an amide

2. The compound of claim 1, wherein the carboxylic acid isostere of R_2 is a carbocycle or heterocycle containing any combination of CH_2 , C , CH , O , S , or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R^3 .

3. The compound of claim 1, wherein R_2 is selected from the following group:

The image displays a collection of chemical structures for various heterocyclic compounds, primarily triazoles, thiazoles, and furans. A large, bold diagonal line is drawn across the center of the page, crossing out several structures. The structures are arranged in a grid-like fashion, with some appearing to be part of a larger set of options or examples.

- Top Row:**
 - 1,2,4-Triazole with a wavy line at position 1.
 - 1,2,4-Triazole with a wavy line at position 1 and a carboxylic acid group (-COOH) at position 5.
 - 1,2,4-Triazole with a wavy line at position 1 and a carboxylic acid group (-COOH) at position 5 (crossed out).
 - 1,2,4-Triazole with a wavy line at position 1 and a hydroxyl group (-OH) at position 5.
- Second Row:**
 - 1,2,4-Triazole with a wavy line at position 1 and a thiol group (-SH) at position 5.
 - Thiazole-2,5-dione with a wavy line at position 4.
 - Thiazole-2,5-dione with a wavy line at position 4 (crossed out).
 - Thiazole-2,5-dione with a wavy line at position 4.
- Third Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Fourth Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Fifth Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Sixth Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Seventh Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Eighth Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Ninth Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
- Tenth Row:**
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.
 - 1,3,4-Oxadiazole-2(1H)-one with a wavy line at position 1.

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

4. The compound of claim 1, wherein the carboxylic acid or carboxylic acid isostere of R_2 is selected from the group consisting of:

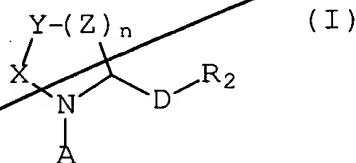
$-\text{COOH}$, $-\text{SO}_3\text{H}$, $-\text{SO}_2\text{HNR}^3$, $-\text{PO}_2(\text{R}^3)_2$, $-\text{CN}$, $-\text{PO}_3(\text{R}^3)_2$, $-\text{OR}^3$, $-\text{SR}^3$, $-\text{NHCOR}^3$, $-\text{N}(\text{R}^3)_2$, $-\text{CON}(\text{R}^3)_2$, $-\text{CONH}(\text{O})\text{R}^3$, $-\text{CONHNHSO}_2\text{R}^3$, $-\text{COHNSO}_2\text{R}^3$, and $-\text{CONR}^3\text{CN}$.

5. The compounds, (2S)-1-(phenylmethyl) carbamoyl-2-hydroxymethyl (4-thiazolidine); (2S)-1-(1,1-dimethylpropyl)carbamoyl-2-(4-thiazolidine)tetrazole; (2S)-1-(phenylmethyl) carbamoyl-2-(4-thiazolidine) carbonitrile; (2S)-1-(1,1-dimethylpropyl)carbamoyl-2-(4-thiazolidine)tetrazole; 3-(3,3-dimethyl-2-oxopentanoyl)-1,3-oxazolidine-4-carboxylic acid; and (2S)-1-(3,3-dimethyl 1,2-dioxopropyl)-2-(3-thiazolidine)carboxylic acid..

6. A pharmaceutical composition, comprising:

- an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring; and
- a pharmaceutically acceptable carrier.

7. The pharmaceutical composition of claim 6, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring comprises a compound of formula (I):



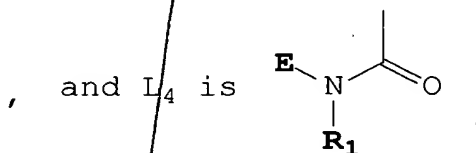
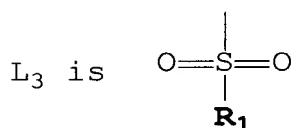
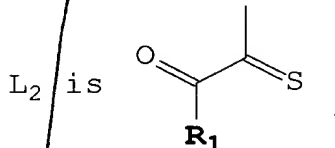
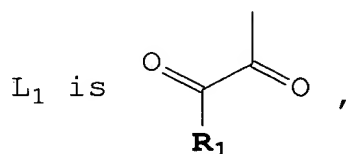
where

X, Y, and Z are independently selected from the group

consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

A is selected from the group consisting of L₁, L₂, L₃, or L₄, where



R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, or heterocycle is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

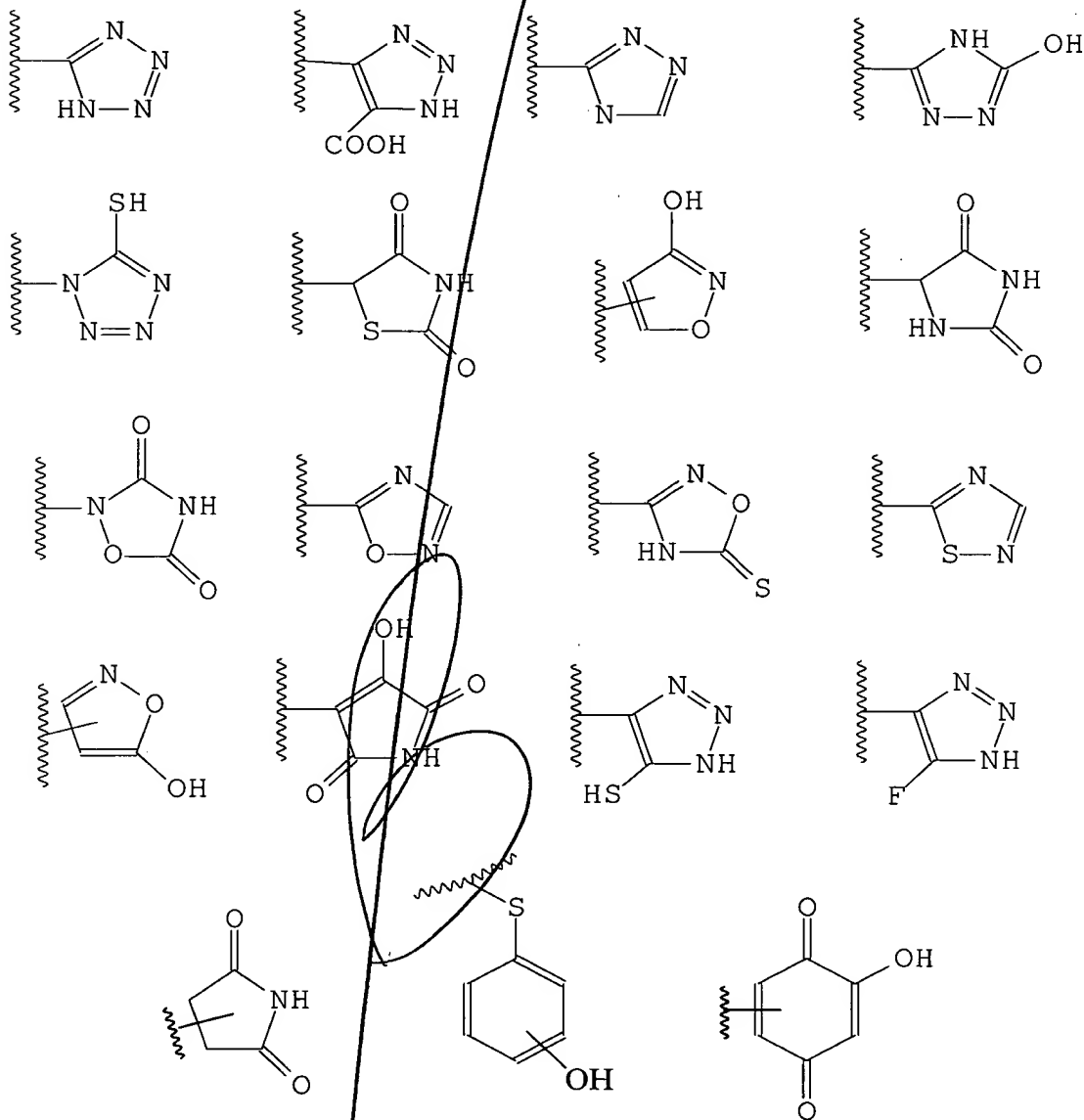
or a pharmaceutically acceptable salt, ester, or solvate thereof.

8. The pharmaceutical composition of claim 7, wherein R₂

is a carbocycle or heterocycle containing any combination of CH_2 , O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R^3 .

5

9. The pharmaceutical composition of claim 7, wherein R_2 is selected from the following group:



where the atoms of said ring structure may be optionally substituted at one or more positions with R³.

10. The pharmaceutical composition of claim 7, wherein R₂ is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³,
-NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³,
-COHNSO₂R³, and -CONR³GN.

11. The pharmaceutical composition of claim 7, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is selected from the group consisting of compounds 1-442, compound L, and compound M.

~~12. The pharmaceutical composition of claim 6, further comprising a neurotrophic factor different from formula (I).~~

~~13. The pharmaceutical composition of claim 12, wherein said neurotrophic factor different from formula (I) is selected from neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3 and neurotrophin 4/5.~~

14. A method of treating a neurological disorder in an animal, comprising:

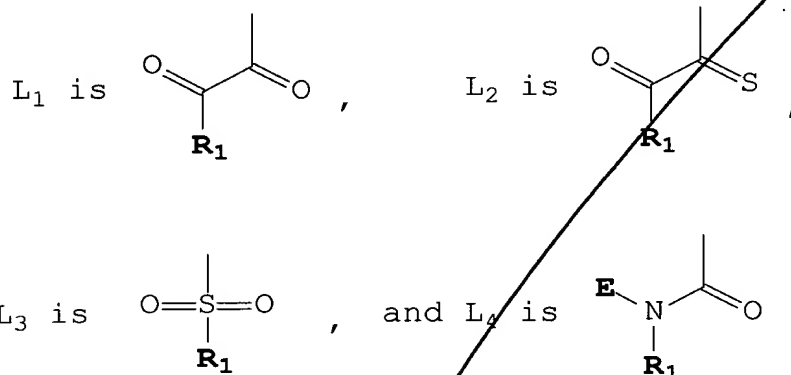
administering to the animal an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring to stimulate growth of damaged peripheral nerves or to promote neuronal regeneration.

X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

5 A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



10 R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

15 D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, or heterocycle is optionally substituted with one or more substituents selected from R³, where

20 R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is 25 hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

24. The method of claim 21, wherein R_2 is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³ON.

25. The method of claim 14, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is selected from the group consisting of compounds 1-442, compound L, and compound M.

~~26. The method of claim 14, further comprising administering a neurotrophic factor different from formula (I).~~

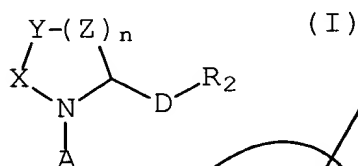
27. The method of claim 26, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

28. A method of stimulating growth of damaged peripheral nerves, comprising:

administering to damaged peripheral nerves an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring to stimulate or promote growth of the damaged peripheral nerves.

29. The method of claim 28, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is non-immunosuppressive.

30. The method of claim 28, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring comprises a compound of formula (I):



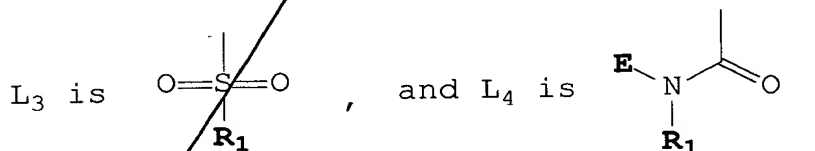
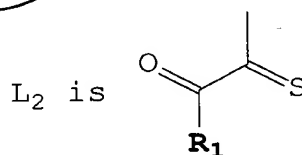
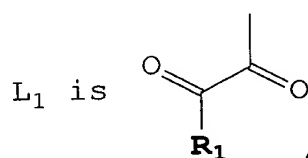
where

X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

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R_2 is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, or heterocycle is optionally substituted with one or more substituents selected from R^3 , where

R^3 is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C_1 - C_6 straight or branched chain alkyl, C_2 - C_6 straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO_2R^4 where R^4 is hydrogen or C_1 - C_9 straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

31. The method of claim 30, wherein R_2 is a carbocycle or heterocycle containing any combination of CH_2 , O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R^3 .

32. The method of claim 30, wherein R_2 is selected from the following group:

[illegible]

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

33. The method of claim 30, wherein R_2 is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

34. The method of claim 28, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is selected from the group consisting of compounds 1-442, compound L, and compound M.

35. The method of claim 28, further comprising administering a neurotrophic factor different from formula (I).

36. The method of claim 35, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

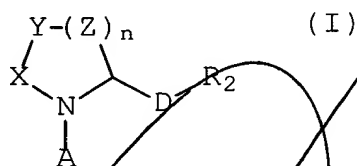
37. A method for promoting neuronal regeneration and growth in animals, comprising:

administering to an animal an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring to promote neuronal regeneration.

38. The method of claim 37, wherein the carboxylic acid or

carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is non-immunosuppressive.

- 5 39. The method of claim 37, wherein the Carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring comprises a compound of formula (I):



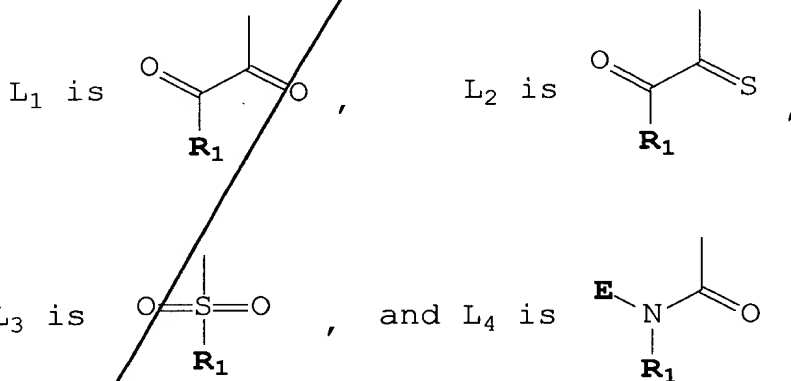
10 where

X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

15 A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



20 R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

25 R₂ is a carboxylic acid or a carboxylic acid isostere;

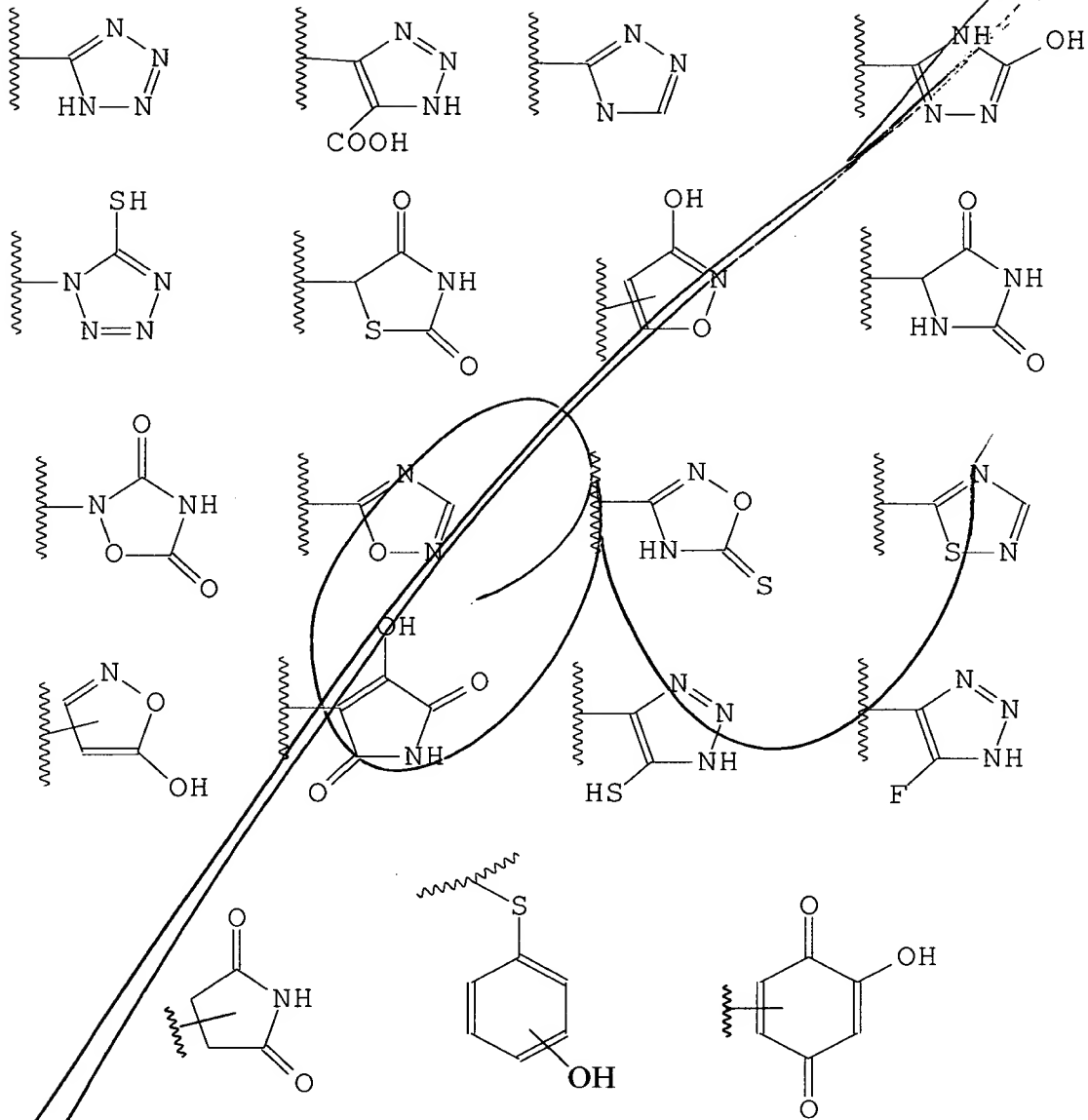
wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, or heterocycle is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

or a pharmaceutically acceptable salt, ester, or solvate thereof.

40. The method of claim 39, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

41. The method of claim 39, wherein R₂ is selected from the following group:

[illegible]

where the atoms of said ring structure may be optionally substituted at one or more positions with R³.

42. The method of claim 39, wherein R₂ is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

43. The method of claim 37, wherein the N-heterocyclic carboxylic acid compound is selected from the group consisting of compounds 1-442, compound L, and compound M.

44. The method of claim 37, further comprising administering a neurotrophic factor different from formula (I).

45. The method of claim 44, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

46. A method for preventing neurodegeneration in an animal, comprising:

administering to an animal an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring to prevent neurodegeneration.

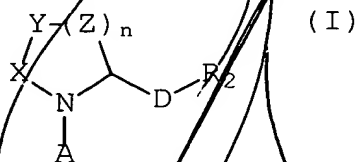
47. The method of claim 46, wherein the neurodegeneration is Alzheimer's disease.

48. The method of claim 46, wherein the neurodegeneration is Parkinson's disease.

49. The method of claim 46, wherein the neurodegeneration is amyotrophic lateral sclerosis.

50. The method of claim 46, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is non-immunosuppressive.

51. The method of claim 46, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring comprises a compound of formula (I):



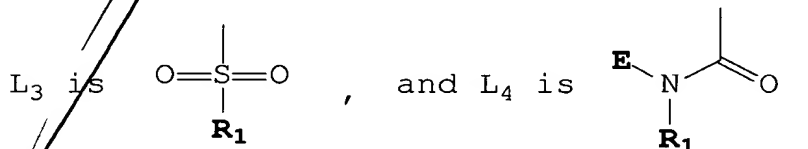
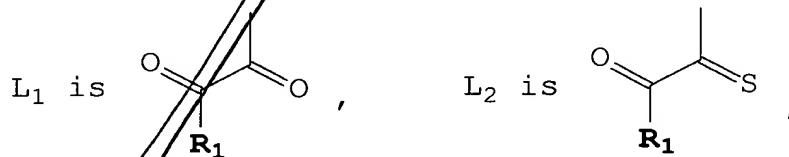
where

X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



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R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

5 D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene; R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, or heterocycle is optionally substituted with one or more substituents selected from R³, where

10 R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

15 or a pharmaceutically acceptable salt, ester, or solvate thereof.

20 52. The method of claim 51, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

25 53. The method of claim 51, wherein R₂ is selected from the following group:

[illegible]

where the atoms of said ring structure may be optionally substituted at one or more positions with R³.

54. The method of claim 51, wherein R₂ is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNH₂SO₂R³, -COHNSO₂R³, and -CONR³CN.

55. The method of claim 46, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is selected from the group consisting of compounds 1-442, compound L, and compound M.

56. The method of claim 46, further comprising administering a neurotrophic factor different from formula (I).

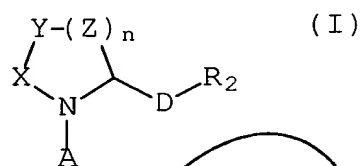
57. The method of claim 56, wherein said neurotrophic factor different from formula (I) is selected from the group consisting of neurotrophic growth factor, brain derived growth factor, glial derived growth factor, ciliary neurotrophic factor, insulin growth factor and active truncated derivatives thereof, acidic fibroblast growth factor, basic fibroblast growth factor, platelet-derived growth factors, neurotrophin-3, and neurotrophin 4/5.

58. A method for treating alopecia or promoting hair growth in an animal, which comprises administering to said animal an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring.

59. The method of claim 58, wherein the carboxylic acid or

carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is non-immunosuppressive.

60. The method of claim 58, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is a compound of formula (I):



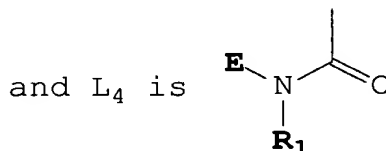
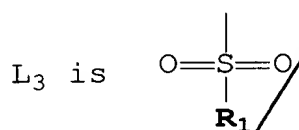
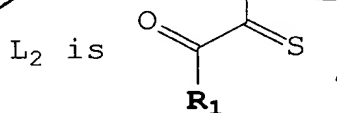
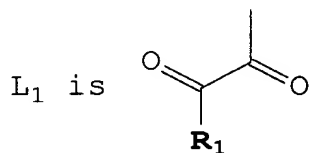
where

X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

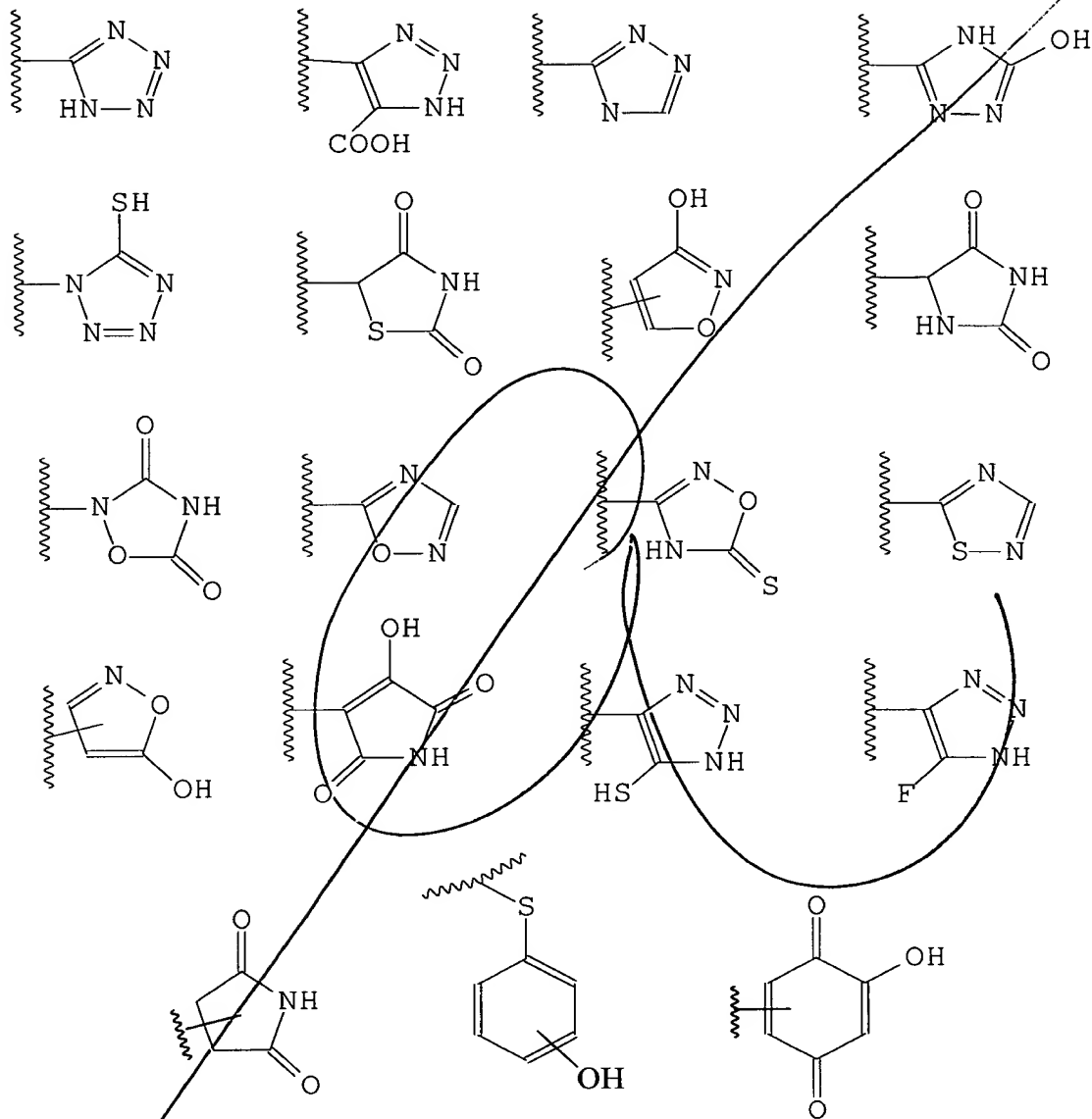
R₂ is a carboxylic acid or a carboxylic acid isostere;

wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl, C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;
or a pharmaceutically acceptable salt, ester, or solvate thereof.

61. The method of claim 60, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

62. The method of claim 60, wherein R₂ is selected from the following group:



where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

63. The method of claim 60, wherein R_2 is selected from the group consisting of

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³, -NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³, -COHNSO₂R³, and -CONR³CN.

64. The method of claim 58, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is selected from the group consisting of compounds 1-442, compound L, and compound M.

65. A pharmaceutical composition comprising:

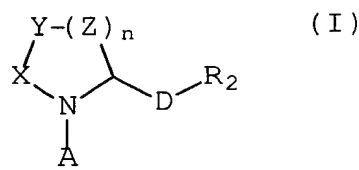
(i) an effective amount of a carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring for treating alopecia or promoting hair growth in an animal; and

(ii) a pharmaceutically acceptable carrier.

66. The pharmaceutical composition of claim 65, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is non-immunosuppressive.

67. The composition of claim 65, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is a compound of formula (I):

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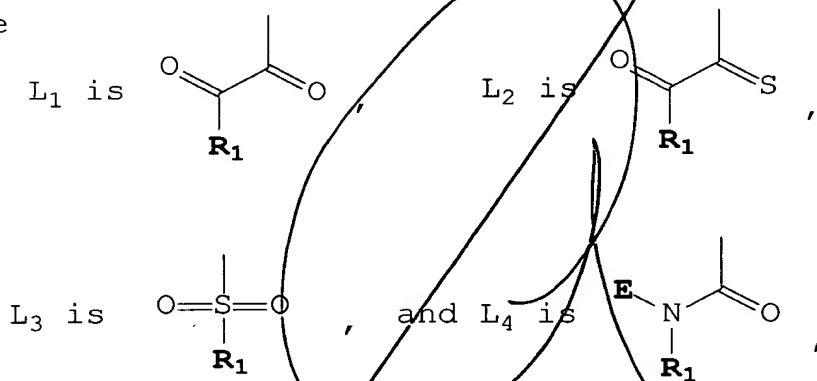
where

X, Y, and Z are independently selected from the group consisting of C, O, S, or N, provided that X, Y, and Z are not all C;

n is 1-3;

A is selected from the group consisting of L₁, L₂, L₃, or L₄,

where



R₁ and E are independently selected from the group consisting of hydrogen, C₁-C₉ straight or branched chain alkyl or alkenyl, C₂-C₉ straight or branched chain alkenyl, aryl, heteroaryl, carbocycle, and heterocycle;

D is selected from the group consisting of a bond, C₁-C₁₀ straight or branched chain alkyl, ethylene, and butylene;

R₂ is a carboxylic acid or a carboxylic acid isostere; wherein said alkyl, alkenyl, alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or carboxylic acid isostere is optionally substituted with one or more substituents selected from R³, where

R³ is hydrogen, hydroxy, halo, haloalkyl, thiocarbonyl, alkoxy, alkenoxy, alkylaryloxy, aryloxy, arylalkyloxy, cyano, nitro, imino, alkylamino, aminoalkyl, sulfhydryl, thioalkyl, alkylthio, sulfonyl, C₁-C₆ straight or branched chain alkyl,

C₂-C₆ straight or branched chain alkenyl or alkynyl, aryl, heteroaryl, carbocycle, heterocycle, or CO₂R⁴ where R⁴ is hydrogen or C₁-C₉ straight or branched chain alkyl or alkenyl;

5 or a pharmaceutically acceptable salt, ester, or solvate thereof.

68. The composition of claim 67, wherein R₂ is a carbocycle or heterocycle containing any combination of CH₂, O, S, or N in any chemically stable oxidation state, wherein any of the atoms of said ring structure are optionally substituted in one or more positions with R³.

69. The composition of claim 67, wherein R₂ is selected from the following group:

The image displays a collection of chemical structures for various nucleobases and nucleosides, arranged in a grid-like fashion. A large, thick, black diagonal line runs from the top-left towards the bottom-right, crossing through several structures. The structures include:

- Purines:** Adenine (top-left), Guanine (top-right), and Hypoxanthine (middle-right).
- Pyrimidines:** Cytosine (top-middle), Uracil (middle-right), Thymine (bottom-right), and Uracil (bottom-middle).
- Nucleosides:** Adenosine (top-right), Guanosine (middle-right), Cytidine (middle-right), and Uracil (bottom-middle).
- Other structures:** A nucleoside with a thiol group (SH) (middle-left), a nucleoside with a hydroxyl group (OH) (middle-left), a nucleoside with a thiol group (HS) (bottom-middle), a nucleoside with a fluorine atom (F) (bottom-right), a nucleoside with a hydroxyl group (OH) (bottom-left), a nucleoside with a thiol group (S) (bottom-left), and a nucleoside with a hydroxyl group (OH) (bottom-right).

where the atoms of said ring structure may be optionally substituted at one or more positions with R^3 .

70. The composition of claim 67, wherein R_2 is selected from the group consisting of:

-COOH, -SO₃H, -SO₂HNR³, -PO₂(R³)₂, -CN, -PO₃(R³)₂, -OR³, -SR³,
-NHCOR³, -N(R³)₂, -CON(R³)₂, -CONH(O)R³, -CONHNHSO₂R³,
-COHNSO₂R³, and -CONR³CN.

71. The composition of claim 65, wherein the carboxylic acid or carboxylic acid isostere of an N-heterocyclic ring compound having two or more heteroatoms in the ring is selected from the group consisting of compounds 1-442, compound L, and compound M.

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